NASA Facts

National Aeronautics and
Space Administration

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The Space Launch Initiative:

Technology to pioneer the space frontier

Space Transportation Directorate

"Let us conquer space."

When U.S. Sen. John Calhoun of South Carolina said those words in 1816, the "space" he referred to was the new frontier west of the U.S. Appalachians.

Calhoun's proposal was one of many at the federal and state level aimed at supporting the construction of roads, canals and railways in order to improve communications and commerce and ultimately strengthening and expanding the new nation.

Governments have long been associated with discovery, exploration, and the opening of new frontiers in support of national interests. In the 15th century, the royal courts of England, Portugal and Spain financed the explorers who discovered, explored and settled the Americas. In the 20th century, the U.S. government helped foster commercial aviation in the early days of air travel.

In the 21st century, NASA is continuing that historic tradition with the 2nd Generation Reusable Launch Vehicle (RLV) program, managed by the Marshall Space Flight Center, NASA's Lead Center for Space Transportation Systems Development. This initiative will ultimately move the nation from the explorations of the Mercury, Gemini, Apollo and Space Shuttle missions to a period of pioneering where people and businesses are more routinely traveling, working and living in space.

GOALS

The 2nd Generation RLV program follows a three-part strategy:

- Investment in technology development and other activities needed to enable full-scale development by 2005 and operations by 2010 of a *commercially competitive, privately owned and operated* launch vehicle that will be 10 times cheaper and 100 times safer than today's rockets.
- Development of a coordinated approach that relies on commercial RLVs to meet NASA's mission needs. Where commercial vehicles alone can't meet NASA's needs — such as planetary exploration and crew rescue — NASA will develop NASA-unique hardware that builds on commercial capabilities.
- Purchase of cargo resupply services for the International Space Station — using near-term, path-finding commercial launch vehicles – to serve as a backup capability for primary vehicles such as the U.S. Space Shuttle and international vehicles such as the Russian Progress rocket.

BACKGROUND

NASA's top new development priority, the 2nd Generation RLV program, is driven by one inescapable fact recognized by NASA, industry, the White House and Congress: Space launch is prohibitively expensive and risky for all but the most lucrative commercial efforts, such as worldwide broadcasting satellites, and missions of the greatest national importance, such as defense, exploration and scientific research.

Whether it's doing business in Earth orbit or exploring distant worlds, the first few hundred kilometers of the Highway to Space are the toughest part of the journey. That's because fully half the energy needed to go to the farthest planets in our solar system is devoted to escaping the Earth's "gravity well" and getting into low earth orbit.

U.S. commercial launch vehicles are based largely on decades-old technology. Foreign companies control the majority of the launch business once dominated by the United States. Even so, some U.S. and foreign rockets fail between 1 and 10 percent of the time.

The Shuttle – the nation's 1st generation reusable system – was developed in the 1970s and began operations in 1981. With improvements for safety and reliability, the fleet is expected to remain in service until at least 2012 or until a 2nd generation system is ready. While the Shuttle opened technological and scientific frontiers, it is not designed to meet the demands of a broader, busier commercial market.

To open space for many more commercial, scientific and personal pursuits and enable exploration of other worlds, space transportation must be much safer, cheaper and more reliable than either commercial launch vehicles or the Shuttle. Transferring NASA's routine space operations needs to the private sector will enable NASA to concentrate on more science research, technology development and exploration.

The National Space Transportation Policy of 1994 highlighted these problems and assigned NASA the lead role for developing reusable launch vehicle technologies. The National Space Policy, signed in1996, reaffirmed these goals.

Meeting such highly ambitious goals will require NASA to focus on leap-ahead technologies that U.S. industry can use to regain market share and create new business opportunities in space. In turn, NASA will realize a reduction in launch costs that currently absorb 25 percent of its annual budget.

NASA has initiated several investments aimed at dramatically improving the cost and reliability of getting to space. Working with industry partners, NASA began the X-33, X-34, and X-37 rocket plane projects to test new RLV technologies and the Advanced Space Transportation program to explore technologies. The X-vehicles focused on developing key technological advances for second generation reusable launch vehicles on the premise that major growth of the commercial launch market would enable significant private financing of a new RLV — once the technology and business risks were reduced.

Through that work, NASA made substantial progress in understanding future space transportation requirements and emerging RLV technologies. NASA also gained better understanding of the balance between commercial and government interests.

Despite progress and several new technologies, there have also been some difficult lessons. Key technology projects have experienced setbacks, and significant technical risks remain. For instance, four U.S. rocket engines that will demonstrate major cost reductions and longer life are being tested, but they need additional work before they're ready for operation.

NASA engineers learned that development along multiple competing technology paths is needed — in addition to pursuing emerging technologies. They learned that requirements for a second generation commercial vehicle must be worked in partnership with industry so that NASA requirements converge with commercial capabilities. NASA also learned that commercial markets are not growing as previously projected, but there are still possibilities in the near-term to pursue alternate paths that can make access to space more robust.

Those lessons were the basis for NASA's industry-led Space Transportation Architecture Studies in 1998 and 1999, and NASA's Integrated Space Transportation Plan developed in the fall of 1999. The former addressed initial requirements, architecture options and technology investment priorities. The latter, intended as an annual exercise, integrated NASA's diverse space transportation activities into a single, comprehensive and integrated investment plan. In addition to a 2nd Generation RLV program, the plan also addresses Shuttle safety upgrades, a Crew Return Vehicle for the International Space Station, and basic aero-space technology research — elements covered in other programs.

Reducing Risk

Today, transferring NASA's space transportation needs to commercial launch vehicles remains the key goal of NASA's space transportation efforts. To earn government support and attract the vast resources of private enterprise, it will require additional investment through the 2nd Generation program to reduce business and technical risks to acceptable levels. Private industry must be assured it can turn a profit with the new RLV, and lawmakers must be sure tax dollars are being invested wisely.

This risk reduction effort is a lesson learned from NASA's experience with its first generation RLV. When NASA started development of a reusable space shuttle in the 1970s, its main engines, solid rocket boosters, and thermal protection system went into development along with it, leading to schedule and cost growth in the Shuttle program.

The 2nd Generation program provides added resources needed to push forward, reach safety and affordability goals and bring on a new age of pioneering and development.

Industry will help define the key program and technology risk areas that will enable at least two competing concepts. Risk reduction activities likely will include business development and planning, technology research, advanced development activities, and flight and ground experiments.

Investments in the 2nd Generation RLV activity will be driven by industry need to assure the highest degree of competition and program success. Earlier studies concluded the highest priority areas for technology investment are crew safety, main propulsion, integrated structures and subsystems. Technology for orbital operations – such as automated rendezvous and docking, propellant transfer, etc. — will also be addressed, as well as avionics, operational technologies and more. Ground and flight tests are part of the risk reduction program.

A key part of the risk reduction effort will be lessons learned from reusable launch vehicle technology demonstrators – the current X-37 program, and the former X-33 and X-34 programs.

After a range of risk reduction activities for two years, NASA expects to focus on the promising areas by 2003, while continuing to assure at least two competitors for a second generation system.

2nd Generation Program begins

In its fiscal 2001 budget request to Congress, the administration requested $4.5 billion for the 2nd Generation RLV program over five years.

In March 2000, NASA called for industry proposals as an initial step in defining detailed requirements and identifying and initiating initial risk reduction options. In May 2000, nine companies were selected for the 2nd Generation RLV Risk Reduction Definition Program. This effort will further define systems requirements for the 2nd Generation RLV program before the business and technical risk reduction efforts begin in fiscal 2001.

These companies, which represent both emerging and established launch companies, are part of this effort to ensure that a second generation architecture responds to the needs of a broad range of potential users. In that way, NASA and its industry partners believe the needs of commercial space transportation and the needs of government both will be met.

The studies will address a space transportation architecture that covers not only possible Earth-to-orbit launch vehicles but also in-space orbit transfer vehicles, ground and flight operations and the technology and organization required to support both.

The risk reduction effort will be a NASA-wide effort and also will involve the U.S. Department of Defense.

Companies selected were Orbital Sciences Corp. of Dulles, Va.; The Boeing Co. of Seal Beach, Calif.; Andrews Space & Technology of El Segundo, Calif.; Lockheed Martin Space Systems Co. of Denver, Colo.; The Boeing Company's Rocketdyne Propulsion and Power Division of Canoga park, Calif.; Pratt & Whitney of West Palm Beach, Fla.; Futron Corp. of Bethesda, Md.; Kelly Space & Technology of San Bernadino, Calif.; and Space Access of Palmdale, Calif.

In August 2000, NASA awarded four small businesses 90-day contracts totaling $902,000 to study how to provide contingency cargo launch services for the International Space Station and what technology development or business planning is needed.

Capable of launching within a week if necessary, the contingency cargo service will enhance the Station's operational flexibility if its primary resuppy vehicles — including the Shuttle and international launchers — are unavailable. The service will help encourage a viable commercial U.S. space transportation industry.

The contracts were set aside for small business under the Alternate Access Project of the Space Launch Initiative. Selected for contracts were Andrews Space and Technology and Microcosm Inc., both of El Segundo, Calif.; HMX Ltd. of Reno, Nev.; and Kistler Aerospace Corp. of Kirkland, Wash.

2nd Generation perspective: a look back and a look forward

In historical context, the 2nd Generation program is important for very down-to-earth reasons. Throughout history, thriving economies have relied on ready access to transportation to enable exploration and trade.

In the case of commercial aviation, the U.S. aerospace industry led the U.S. economy in worldwide net exports, exceeding agriculture by a factor of two. That economic dynamo didn't arise overnight. Over the last century, at least six generations of aircraft have been developed, starting with the Wright flyer and ending with the Boeing 777. Major technological advances led to more capable aircraft and new markets from mail, passenger service, package delivery and interstate commerce. Each contributed to our nation's economic health. Investment in space transportation will lead to similar results in the worldwide commercial space marketplace.

Second generation RLVs will have crew escape systems. They will require launch crews of around 10 people, compared to 170 today. They will need only a week's preparation for reflight, compared to today's five months. And they will fly a hundred times a year, compared to today's 10 times or less.

With the technologies they use and the operations enabled by those technologies, the probability of losing a crew will be no worse than 1 in 10,000 missions – roughly the same as the risk of losing a military jet fighter. And the cost of delivering a pound of payload to low Earth orbit will drop from $10,000 to $1,000 per pound.

The 2nd Generation RLV program will revitalize the nation's space transportation capabilities by enabling the United States to recapture the worldwide commercial space markets while dramatically improving transportation capabilities for NASA's science and exploration missions.

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